

Name_____ Chemistry I: Don't Freeze the Engine

Period_____ Date_____

In this activity you will read an antifreeze chart, determine how much fluid to drain from a vehicle's cooling system to replace with pure antifreeze (or water) to have the desired mix to protect the engine from freezing at various climate temperatures. You need to know how to solve problems using percents and to calculate percent concentrations.

The chart below is typical of what you might find on a container of antifreeze for a vehicle's engine cooling system. The temperatures (in the middle of the table) are degrees Fahrenheit.

Cooling System Capacity in Quarts	Quarts of Antifreeze\Coolant required to obtain protection for the temperatures listed											
	1	2	3	4	5	6	7	8	9	10	12	13
8				-34								
9	24	14	0	-21	-50							
10	25	16	4	-12	-34	-62						
11	26	18	8	-6	-23	-47						
12		19	10	0	-15	-34	-57					
13		21	13	3	-9	-25	-45	-66				
14			15	6	-8	-18	-34	-54				
15			16	8	0	-12	-26	-43				
16			17	10	2	-8	-19	-34				
17			18	12	5	-4	-14	-27				
18			19	14	7	0	-10	-21	-34	-50	-65	
19			20	15	9	2	-7	-16	-28	-42	-65	
20				16	10	4	-3	-12	-22	-34	-48	-62

Part 1: Reading the Antifreeze Chart

1. The highest temperature in the above chart is 26°F and the lowest temperature -66°F. Explain why there would be no need to include temperatures outside of that range.
2. Name some areas of the country where this chart would be irrelevant. Explain why.

- Record the number of quarts antifreeze that would be needed to protect an engine with the following systems at the given temperatures.

System and Temp.	Quarts Antifreeze	System and Temp.	Quarts Antifreeze
18 qt system, -10°F		10 qt system, 16°F	
15 qt system, 0°F		15 qt system, -43°F	

Part 2: Getting the Right Mix in the System—Analyzing the Problem Numerically

Information: A 20-quart engine cooling/antifreeze system currently has a mix of water and antifreeze to protect the engine down to 10°F.

- Based on the above information and the antifreeze chart, fill in following. In later steps, the information will help you determine how to adjust the fluid in the current system to obtain - 48°F level engine protection.

	Explain How You Know or Show How You Calculated the Answer.
Cooling system capacity: _____	
Current level of protection: _____	
Current amount of antifreeze: _____	
Current amount of water: _____	
% concentration antifreeze in system: _____	
% concentration water in system: _____	
Quarts antifreeze needed for target protection level: _____	
Quarts water needed for target protection level: _____	
% concentration antifreeze for target protection level: _____	

5. Write a word formula to describe how the total amount of fluid in the system, percent concentration of antifreeze, and amount of pure antifreeze in the system are related.

6. Identify and describe the unknown quantities and assign a variable to each unknown.

Word Description of Unknown	Variable to represent unknown

Summary questions:

7. How do you determine percent concentration of antifreeze in a system?
8. Suppose you had a leaky radiator (or a leak somewhere else in the coolant system) and added water. Describe what impact the leak and refilling the radiator with water has on the percent concentration of antifreeze in the system.
9. Willie read on the antifreeze protection chart that to get a 10° protection level in a 20 quart system that he should have 4 quarts antifreeze and 16 quarts water. Since $4/16 = 25\%$, he concluded he needed a 25% percent concentration. Explain what is wrong with his reasoning.